

Exposure science in the 21st century

By Annah Wyss

Paul Lioy, Ph.D, professor of environmental and occupational medicine at Rutgers University, shared his vision for exposure science in the 21st century, during an April 3 seminar co-hosted by NIEHS and the U.S. Environmental Protection Agency (EPA). The talk was held on the EPA campus in Research Triangle Park, N.C. Using a National Research Council [report](http://www.nap.edu/catalog.php?record_id=13507) (http://www.nap.edu/catalog.php?record_id=13507) on exposure science as a foundation for his talk, Lioy (<http://eohsi.rutgers.edu/content/directory?profile=73>) stressed the need for collaboration across environmental health fields, to deliver knowledge that is effective, timely, and improves health.

From external sources to internal doses

In outlining the goals of exposure science, Lioy first emphasized the need to examine the link between external exposure and the resulting internal doses. He highlighted several tools that have enhanced efforts to accomplish this goal in recent years, including use of biomarkers; evaluation of source-exposure and source-disease relationships; consideration of the exposome - a measure of lifetime exposures, both internal and external; development of comprehensive exposure datasets; and incorporation of a systems approach.

"Exposure science examines intensity and duration of the contact of humans or other organisms with agents, and the relationship to health," Lioy explained.

To demonstrate the value of developing comprehensive exposure datasets, he described his group's work to establish a user-friendly system, known as NJ Risk, which will query existing national and international databases for chemicals both old and new. The system, designed by [Panos Georgopoulos, Ph.D.](http://eohsi.rutgers.edu/content/directory?profile=63), (<http://eohsi.rutgers.edu/content/directory?profile=63>) also at Rutgers, will then estimate exposures, in order to computationally characterize the associated health risks.

Goals and applications

In addition to better characterizing internal doses resulting from exposures to external sources, Lioy identified the goals of exposure science as encompassing the identification of multiple levels of exposure and interactions between multiple stressors, exploring exposures in conjunction with lifestyle and behavioral factors, and scaling research from molecular systems to individuals to vulnerable populations to ecosystems.

"We need to understand time, activity, and behavior better," he said, with respect to exposures to substances such as environmental toxins. Though useful, most available data sets were collected before 2000, and do not capture changes in lifestyle that have occurred in the 21st century, such as the prevalence of cell phone use.

To better estimate exposure, Lioy said that investigators must track both existing and emerging chemicals, characterize the health effects of low-level stressors, rapidly respond to natural and human-caused disasters, and maintain local and global environments, by identifying and controlling potential health hazards.

Expansion and integration

Lioy closed by outlining three new opportunities to expand and integrate exposure science - the exposome, the microbiome, and precision environmental health, which focuses on exposures at the individual level. "Integration within environmental health will lead toward a focus on individual health," Lioy concluded.

(Annah Wyss, Ph.D., is a research fellow with the NIEHS Genetics, Environment, and Respiratory Disease Group.)



Lioy is an expert in the field of exposure science and has researched a wide range of air pollutants. He recently served as vice chair of the National Research Council Committee on Human and Environmental Exposure Science in the 21st Century. (Photo courtesy of Steve McCaw)



Daniel Vallero, Ph.D., environmental scientist with EPA, hosted Lioy and moderated the question-and-answer session. (Photo courtesy of Steve McCaw)

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